SEQUENCE LISTING

<110> KYOWA HAKKO KOGYO CO., LTD

<120> Method for producing amino acid

<130> 1657

<160> 16
<170> PatentIn Ver. 3.1

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gaa atc gca cct tcc act cga cag atc ctg ggc tcc cag gaa aac gtc   240
Glu Ile Ala Pro Ser Thr Arg Gln Ile Leu Gly Ser Gln Glu Asn Val
65                  70                  75                  80

aac gtc atc aag ggc gaa gtc acc gac atc aac gtc gag tcc cag act   288
Asn Val Ile Lys Gly Glu Val Thr Asp Ile Asn Val Glu Ser Gln Thr
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gtg acc gcc tcc ctg ggc gag ttc acc cgc gtt ttt gag tac gat tcc   336
Val Thr Ala Ser Leu Gly Glu Phe Thr Arg Val Phe Glu Tyr Asp Ser
            100                 105                 110

ttg gtc gtt ggt gct ggc gca ggt cag tcc tac ttc ggc aat gat cac   384
Leu Val Val Gly Ala Gly Ala Gly Gln Ser Tyr Phe Gly Asn Asp His
        115                 120                 125

ttc gct gag ttc gca cct ggc atg aag tcc atc gac gat gca ctg gag   432
Phe Ala Glu Phe Ala Pro Gly Met Lys Ser Ile Asp Asp Ala Leu Glu
    130                 135                 140

att cgt gca cgc atc atc ggt gct ttc gag cgc gct gag atc tgc gag   480
Ile Arg Ala Arg Ile Ile Gly Ala Phe Glu Arg Ala Glu Ile Cys Glu
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gat cca gct gag cgc gaa cgc ctg ctc acc ttc gtc gtt gtt ggc gct   528
Asp Pro Ala Glu Arg Glu Arg Leu Leu Thr Phe Val Val Val Gly Ala
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ggc cca acc ggt gtt gag ctt gct ggc cag ttg gct gag atg gct cac   576
Gly Pro Thr Gly Val Glu Leu Ala Gly Gln Leu Ala Glu Met Ala His
            180                 185                 190

cgc acc ctt gct ggt gag tac aag aac ttc aac acc aac tcc gca aag   624
Arg Thr Leu Ala Gly Glu Tyr Lys Asn Phe Asn Thr Asn Ser Ala Lys
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atc atc ctg ctt gat ggt gct cca cag gtt ctt cct cca ttc ggt aag   672
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Val Arg Leu Asn Ala Met Val Thr Asn Val Asp Ala Thr Ser Val Thr
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tac aag acc aag gac ggc gaa gag cac acc atc gaa tct ttc tgc aag   816
Tyr Lys Thr Lys Asp Gly Glu Glu His Thr Ile Glu Ser Phe Cys Lys
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gag cag acc ggt gtt gag acc gac cgc gca ggc cgc gtc atg gtt aac   912
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gat gac ctg tct gtt ggc gat cag aag aac gtc ttc gtt gtt ggc gac   960
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1056
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            340                 345                 350

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Ser Asn Thr Glu Arg Glu Ala Phe Asp Tyr Phe Asp Lys Gly Ser Met
        355                 360                 365

gct acc att tcc cgc ttc tcc gca gtg gtg aag atg ggc aag gtt gag
1152
Ala Thr Ile Ser Arg Phe Ser Ala Val Val Lys Met Gly Lys Val Glu
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gtc acc ggc ttc atc ggt tgg gtt ctg tgg ttg gct gtt cac atc atg
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Val Thr Gly Phe Ile Gly Trp Val Leu Trp Leu Ala Val His Ile Met
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Leu Asn Ala Leu Ser Arg Lys Arg Trp Asn Leu Ala Thr Thr Arg Gln
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Gln Leu His Ser Arg Thr Thr Leu Ser Lys Phe Ala His Glu Leu Glu
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            20                  25                  30

Lys Ala Asp Val Asp Val Thr Leu Ile Asp Arg Thr Asn His His Leu
        35                  40                  45

Phe Gln Pro Leu Leu Tyr Gln Val Ala Thr Gly Ile Leu Ser Ser Gly
    50                  55                  60


Glu Ile Ala Pro Ser Thr Arg Gln Ile Leu Gly Ser Gln Glu Asn Val
65                  70                  75                  80

Asn Val Ile Lys Gly Glu Val Thr Asp Ile Asn Val Glu Ser Gln Thr
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Val Thr Ala Ser Leu Gly Glu Phe Thr Arg Val Phe Glu Tyr Asp Ser
            100                 105                 110
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Leu Val Val Gly Ala Gly Ala Gly Gln Ser Tyr Phe Gly Asn Asp His
115 120 125

Phe Ala Glu Phe Ala Pro Gly Met Lys Ser Ile Asp Asp Ala Leu Glu
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Ile Arg Ala Arg Ile Ile Gly Ala Phe Glu Arg Ala Glu Ile Cys Glu
145 150 155 160

Asp Pro Ala Glu Arg Glu Arg Leu Leu Thr Phe Val Val Val Gly Ala
165 170 175

Gly Pro Thr Gly Val Glu Leu Ala Gly Gln Leu Ala Glu Met Ala His
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Arg Thr Leu Ala Gly Glu Tyr Lys Asn Phe Asn Thr Asn Ser Ala Lys
195 200 205

Ile Ile Leu Leu Asp Gly Ala Pro Gln Val Leu Pro Pro Phe Gly Lys
210 215 220

Arg Leu Gly Arg Asn Ala Gln Arg Thr Leu Glu Lys Met Gly Val Asn
225 230 235 240

Val Arg Leu Asn Ala Met Val Thr Asn Val Asp Ala Thr Ser Val Thr
245 250 255

Tyr Lys Thr Lys Asp Gly Glu Glu His Thr Ile Glu Ser Phe Cys Lys
260 265 270

Ile Trp Ser Ala Gly Val Ala Ala Ser Pro Leu Gly Lys Leu Val Ala
275 280 285

Glu Gln Thr Gly Val Glu Thr Asp Arg Ala Gly Arg Val Met Val Asn
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Asp Asp Leu Ser Val Gly Asp Gln Lys Asn Val Phe Val Val Gly Asp
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325 330 335

Ser Gly Glu Tyr Val Ala Glu Gln Ile Glu Ala Glu Val Glu Gly Arg
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Ser Asn Thr Glu Arg Glu Ala Phe Asp Tyr Phe Asp Lys Gly Ser Met
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Ala Thr Ile Ser Arg Phe Ser Ala Val Val Lys Met Gly Lys Val Glu

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    370                 375                 380

Val Thr Gly Phe Ile Gly Trp Val Leu Trp Leu Ala Val His Ile Met
385                 390                 395                 400

Phe Leu Val Gly Phe Arg Asn Arg Phe Val Ser Ala Ile Ser Trp Gly
                405                 410                 415

Leu Asn Ala Leu Ser Arg Lys Arg Trp Asn Leu Ala Thr Thr Arg Gln
            420                 425                 430

Gln Leu His Ser Arg Thr Thr Leu Ser Lys Phe Ala His Glu Leu Glu
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Ser Gly Lys
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Val Ile Gly Ser Gly Phe Gly Gly Leu Phe Ala Val Gln Asn Leu Lys
            20                  25                  30

gat gca gat gtc gat atc acc ctc atc gac cgg aca aac cac cac ctt   144
Asp Ala Asp Val Asp Ile Thr Leu Ile Asp Arg Thr Asn His His Leu
        35                  40                  45

ttc cag ccg ttg ctt tac caa gta gca acc ggt atc ttg tcg tct ggt   192
Phe Gln Pro Leu Leu Tyr Gln Val Ala Thr Gly Ile Leu Ser Ser Gly
    50                  55                  60

gaa atc gca cca caa acg cgt caa gtt ctt gca cag caa aat aat gtg   240
Glu Ile Ala Pro Gln Thr Arg Gln Val Leu Ala Gln Gln Asn Asn Val
65                  70                  75                  80
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cac gtt ctt aag gct gaa gtc acc gac att gac acc gaa tcg aag acg   288
His Val Leu Lys Ala Glu Val Thr Asp Ile Asp Thr Glu Ser Lys Thr
                 85                  90                  95

gtc gtc gca gac ttg gat gat tat tct aaa aca att gaa tac gat tcc   336
Val Val Ala Asp Leu Asp Asp Tyr Ser Lys Thr Ile Glu Tyr Asp Ser
            100                 105                 110

ctg atc gtc gcc gct ggt gca ggt cag tct tac ttc gga aat gat cac   384
Leu Ile Val Ala Ala Gly Ala Gly Gln Ser Tyr Phe Gly Asn Asp His
        115                 120                 125

ttc gcg gaa ttc gcg ccg ggt atg aaa aca atc gat gat gca ctc gaa   432
Phe Ala Glu Phe Ala Pro Gly Met Lys Thr Ile Asp Asp Ala Leu Glu
    130                 135                 140

ctg cgt gcg cgc atc atc ggc gct ttc gaa cgc gca gaa atg tgc gaa   480
Leu Arg Ala Arg Ile Ile Gly Ala Phe Glu Arg Ala Glu Met Cys Glu
145                 150                 155                 160

gat ccc aaa gaa cgt gaa cgc ctc ttg act ttt gtt atc gtt ggc gca   528
Asp Pro Lys Glu Arg Glu Arg Leu Leu Thr Phe Val Ile Val Gly Ala
                165                 170                 175


gga cca aca ggc gta gaa ctt gca ggt cag ctg gcc gaa atg gca cac   576
Gly Pro Thr Gly Val Glu Leu Ala Gly Gln Leu Ala Glu Met Ala His
            180                 185                 190

cgc acg ttg tct gga gag tac acg cag ttc acg cct tcc aac gcg aag   624
Arg Thr Leu Ser Gly Glu Tyr Thr Gln Phe Thr Pro Ser Asn Ala Lys
        195                 200                 205

atc atc ctg ctt gac ggc gct cct cag gtg ctt cca ccg ttc ggc aag   672
Ile Ile Leu Leu Asp Gly Ala Pro Gln Val Leu Pro Pro Phe Gly Lys
    210                 215                 220

cgt ttg ggt cgt act gca cag cgt gaa tta gaa aag att ggt gta acg   720
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225                 230                 235                 240

gtc aag ctg aac gct atc gtt acc ggc gta gac gaa aac tca gtg aca   768
Val Lys Leu Asn Ala Ile Val Thr Gly Val Asp Glu Asn Ser Val Thr
                245                 250                 255

tat aag tcc acc gtt gat gat tct ttg cac acg atc gat tcc ttc tgc   816
Tyr Lys Ser Thr Val Asp Asp Ser Leu His Thr Ile Asp Ser Phe Cys
            260                 265                 270
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aag atc tgg tcg gca ggc gta gcc gct tcc cca cta ggc aaa cta gtt   864
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gca gag cag ctt ggt gtc gag gtt gat cgt gca gga cgc gtc cca gtc   912
Ala Glu Gln Leu Gly Val Glu Val Asp Arg Ala Gly Arg Val Pro Val
    290                 295                 300

aac gaa gat ctt tct gtt ggc gac gat aag aac gtc ttt gtt att ggc   960
Asn Glu Asp Leu Ser Val Gly Asp Asp Lys Asn Val Phe Val Ile Gly
305                 310                 315                 320

gat atg atg tcg ctc aac agg ctt ccg gga gtc gca cag gta gca atc
1008
Asp Met Met Ser Leu Asn Arg Leu Pro Gly Val Ala Gln Val Ala Ile
                325                 330                 335

caa ggc ggt gaa tac gtt gct gag cag att gct gct ggg gtc gag gga
1056
Gln Gly Gly Glu Tyr Val Ala Glu Gln Ile Ala Ala Gly Val Glu Gly
            340                 345                 350

cgt tcc tcg tct gaa cgc cca gcc ttt gaa tac tac gac aag ggt tcg
1104
Arg Ser Ser Ser Glu Arg Pro Ala Phe Glu Tyr Tyr Asp Lys Gly Ser
        355                 360                 365

atg gct acg gtg tcg cgc ttt aac gcc gtt gtg aag ctt gga aaa gtt
1152
Met Ala Thr Val Ser Arg Phe Asn Ala Val Val Lys Leu Gly Lys Val
    370                 375                 380

gaa gtt acg gga ttt att ggc tgg gtc atg tgg ctt ctc gtc cac ttg
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Glu Val Thr Gly Phe Ile Gly Trp Val Met Trp Leu Leu Val His Leu
385                 390                 395                 400

atg ttc ttg gtc ggc ttc cgc aac cga gca act gcg gct ttc tct tgg
1248
Met Phe Leu Val Gly Phe Arg Asn Arg Ala Thr Ala Ala Phe Ser Trp
                405                 410                 415

ggc atc aat gcg ctt tca cgt aag cgt tgg aac ctc gcc acc act cgt
1296
Gly Ile Asn Ala Leu Ser Arg Lys Arg Trp Asn Leu Ala Thr Thr Arg
            420                 425                 430

cag cag ctt cac ggc cgt act ggt ttg caa aaa ctt act gcg ctc gtc
1344
Gln Gln Leu His Gly Arg Thr Gly Leu Gln Lys Leu Thr Ala Leu Val
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Asp Ala Asp Val Asp Ile Thr Leu Ile Asp Arg Thr Asn His His Leu
        35                  40                  45

Phe Gln Pro Leu Leu Tyr Gln Val Ala Thr Gly Ile Leu Ser Ser Gly
    50                  55                  60

Glu Ile Ala Pro Gln Thr Arg Gln Val Leu Ala Gln Gln Asn Asn Val
65                  70                  75                  80

His Val Leu Lys Ala Glu Val Thr Asp Ile Asp Thr Glu Ser Lys Thr
                85                  90                  95

Val Val Ala Asp Leu Asp Asp Tyr Ser Lys Thr Ile Glu Tyr Asp Ser
            100                 105                 110

Leu Ile Val Ala Ala Gly Ala Gly Gln Ser Tyr Phe Gly Asn Asp His
        115                 120                 125

Phe Ala Glu Phe Ala Pro Gly Met Lys Thr Ile Asp Asp Ala Leu Glu
    130                 135                 140

Leu Arg Ala Arg Ile Ile Gly Ala Phe Glu Arg Ala Glu Met Cys Glu
145                 150                 155                 160

Asp Pro Lys Glu Arg Glu Arg Leu Leu Thr Phe Val Ile Val Gly Ala
                165                 170                 175

Gly Pro Thr Gly Val Glu Leu Ala Gly Gln Leu Ala Glu Met Ala His
            180                 185                 190

Arg Thr Leu Ser Gly Glu Tyr Thr Gln Phe Thr Pro Ser Asn Ala Lys
        195                 200                 205
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Ile Ile Leu Leu Asp Gly Ala Pro Gln Val Leu Pro Pro Phe Gly Lys
210 215 220

Arg Leu Gly Arg Thr Ala Gln Arg Glu Leu Glu Lys Ile Gly Val Thr
225 230 235 240

Val Lys Leu Asn Ala Ile Val Thr Gly Val Asp Glu Asn Ser Val Thr
245 250 255

Tyr Lys Ser Thr Val Asp Asp Ser Leu His Thr Ile Asp Ser Phe Cys
260 265 270

Lys Ile Trp Ser Ala Gly Val Ala Ala Ser Pro Leu Gly Lys Leu Val
275 280 285

Ala Glu Gln Leu Gly Val Glu Val Asp Arg Ala Gly Arg Val Pro Val
290 295 300

Asn Glu Asp Leu Ser Val Gly Asp Asp Lys Asn Val Phe Val Ile Gly
305 310 315 320

Asp Met Met Ser Leu Asn Arg Leu Pro Gly Val Ala Gln Val Ala Ile
325 330 335

Gln Gly Gly Glu Tyr Val Ala Glu Gln Ile Ala Ala Gly Val Glu Gly
340 345 350

Arg Ser Ser Ser Glu Arg Pro Ala Phe Glu Tyr Tyr Asp Lys Gly Ser
355 360 365

Met Ala Thr Val Ser Arg Phe Asn Ala Val Val Lys Leu Gly Lys Val
370 375 380

Glu Val Thr Gly Phe Ile Gly Trp Val Met Trp Leu Leu Val His Leu
385 390 395 400

Met Phe Leu Val Gly Phe Arg Asn Arg Ala Thr Ala Ala Phe Ser Trp
405 410 415

Gly Ile Asn Ala Leu Ser Arg Lys Arg Trp Asn Leu Ala Thr Thr Arg
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ggg ctg gaa atg gca aca cag ctg ggg cat aag ctg gga cgc aag aaa   96
Gly Leu Glu Met Ala Thr Gln Leu Gly His Lys Leu Gly Arg Lys Lys
            20                  25                  30

aaa gcc aaa att acg ctg gtc gat cgt aac cac agc cac ctg tgg aaa   144
Lys Ala Lys Ile Thr Leu Val Asp Arg Asn His Ser His Leu Trp Lys
        35                  40                  45

ccg ctg ctg cac gaa gtg gcg act ggc tcg ctt gat gaa ggc gtc gat   192
Pro Leu Leu His Glu Val Ala Thr Gly Ser Leu Asp Glu Gly Val Asp
    50                  55                  60

gcg ttg agc tat ctg gcc cat gcg cgc aat cat ggt ttc cag ttc cag   240
Ala Leu Ser Tyr Leu Ala His Ala Arg Asn His Gly Phe Gln Phe Gln
65                  70                  75                  80

ctg ggt tcc gtc att gat att gat cgt gaa gcg aaa aca atc act att   288
Leu Gly Ser Val Ile Asp Ile Asp Arg Glu Ala Lys Thr Ile Thr Ile
                85                  90                  95

gca gaa ctg cgc gac gag aaa ggt gaa ctg ctg gtt ccg gaa cgt aaa   336
Ala Glu Leu Arg Asp Glu Lys Gly Glu Leu Leu Val Pro Glu Arg Lys
            100                 105                 110

atc gcc tat gac acc ctg gta atg gcg ctg ggt agc acc tct aac gat   384
Ile Ala Tyr Asp Thr Leu Val Met Ala Leu Gly Ser Thr Ser Asn Asp
        115                 120                 125

ttc aat acg cca ggt gtc aaa gag aac tgc att ttc ctc gat aac ccg   432
Phe Asn Thr Pro Gly Val Lys Glu Asn Cys Ile Phe Leu Asp Asn Pro
    130                 135                 140

cac cag gcg cgt cgc ttc cac cag gag atg ctg aat ttg ttc ctg aaa   480
His Gln Ala Arg Arg Phe His Gln Glu Met Leu Asn Leu Phe Leu Lys
145                 150                 155                 160
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tac tcc gcc aac ctg ggc gcg aat ggc aaa gtg aac att gcg att gtc   528
Tyr Ser Ala Asn Leu Gly Ala Asn Gly Lys Val Asn Ile Ala Ile Val
                165                 170                 175

ggc ggc ggc gcg acg ggt gta gaa ctc tcc gct gaa ttg cac aac gcg   576
Gly Gly Gly Ala Thr Gly Val Glu Leu Ser Ala Glu Leu His Asn Ala
            180                 185                 190

gtc aag caa ctg cac agc tac ggt tac aaa ggc ctg acc aac gaa gcc   624
Val Lys Gln Leu His Ser Tyr Gly Tyr Lys Gly Leu Thr Asn Glu Ala
        195                 200                 205

ctg aac gta acg ctg gta gaa gcg gga gaa cgt att ttg cct gcg tta   672
Leu Asn Val Thr Leu Val Glu Ala Gly Glu Arg Ile Leu Pro Ala Leu
    210                 215                 220

ccg cca cgt atc tct gct gcg gcc cac aac gag cta acg aaa ctt ggc   720
Pro Pro Arg Ile Ser Ala Ala Ala His Asn Glu Leu Thr Lys Leu Gly
225                 230                 235                 240

gtt cgc gtg ctg acg caa acc atg gtc acc agt gct gat gaa ggc ggc   768
Val Arg Val Leu Thr Gln Thr Met Val Thr Ser Ala Asp Glu Gly Gly
                245                 250                 255

ctg cac act aaa gat ggc gaa tat att gag gct gat ctg atg gta tgg   816
Leu His Thr Lys Asp Gly Glu Tyr Ile Glu Ala Asp Leu Met Val Trp
            260                 265                 270

gca gcc ggg atc aaa gcg cca gac ttc ctg aaa gat atc ggt ggt ctt   864
Ala Ala Gly Ile Lys Ala Pro Asp Phe Leu Lys Asp Ile Gly Gly Leu
        275                 280                 285

gaa act aac cgt atc aac cag ctg gtg gtg gaa ccg acg ctg caa acc   912
Glu Thr Asn Arg Ile Asn Gln Leu Val Val Glu Pro Thr Leu Gln Thr
    290                 295                 300

acc cgc gat cca gac att tac gct att ggc gac tgc gcg tca tgc ccg   960
Thr Arg Asp Pro Asp Ile Tyr Ala Ile Gly Asp Cys Ala Ser Cys Pro
305                 310                 315                 320

cgt ccg gaa ggg ggc ttt gtt ccg ccg cgt gct cag gct gca cac cag
1008
Arg Pro Glu Gly Gly Phe Val Pro Pro Arg Ala Gln Ala Ala His Gln
                325                 330                 335

atg gcg act tgc gca atg aac aac att ctg gcg cag atg aac ggt aag
1056
Met Ala Thr Cys Ala Met Asn Asn Ile Leu Ala Gln Met Asn Gly Lys
            340                 345                 350
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ccg ctg aaa aat tat cag tat aaa gat cat ggt tcg ctg gta tcg ctg
1104
Pro Leu Lys Asn Tyr Gln Tyr Lys Asp His Gly Ser Leu Val Ser Leu
        355                 360                 365

tcg aac ttc tcc acc gtc ggt agc ctg atg ggt aac ctg acg cgc ggc
1152
Ser Asn Phe Ser Thr Val Gly Ser Leu Met Gly Asn Leu Thr Arg Gly
    370                 375                 380

tca atg atg att gaa gga cga att gcg cgc ttt gta tat atc tcg cta
1200
Ser Met Met Ile Glu Gly Arg Ile Ala Arg Phe Val Tyr Ile Ser Leu
385                 390                 395                 400

tac cga atg cat cag att gcg ctg cat ggt tac ttt aaa acc gga tta
1248
Tyr Arg Met His Gln Ile Ala Leu His Gly Tyr Phe Lys Thr Gly Leu
                405                 410                 415

atg atg ctg gtg ggg agt att aac cgc gtt atc cgt ccg cgt ttg aag
1296
Met Met Leu Val Gly Ser Ile Asn Arg Val Ile Arg Pro Arg Leu Lys
            420                 425                 430

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             20                  25                  30

Lys Ala Lys Ile Thr Leu Val Asp Arg Asn His Ser His Leu Trp Lys
         35                  40                  45

Pro Leu Leu His Glu Val Ala Thr Gly Ser Leu Asp Glu Gly Val Asp
     50                  55                  60

Ala Leu Ser Tyr Leu Ala His Ala Arg Asn His Gly Phe Gln Phe Gln
 65                  70                  75                  80

Leu Gly Ser Val Ile Asp Ile Asp Arg Glu Ala Lys Thr Ile Thr Ile
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85 90 95

Ala Glu Leu Arg Asp Glu Lys Gly Glu Leu Leu Val Pro Glu Arg Lys
100 105 110

Ile Ala Tyr Asp Thr Leu Val Met Ala Leu Gly Ser Thr Ser Asn Asp
115 120 125

Phe Asn Thr Pro Gly Val Lys Glu Asn Cys Ile Phe Leu Asp Asn Pro
130 135 140

His Gln Ala Arg Arg Phe His Gln Glu Met Leu Asn Leu Phe Leu Lys
145 150 155 160

Tyr Ser Ala Asn Leu Gly Ala Asn Gly Lys Val Asn Ile Ala Ile Val
165 170 175

Gly Gly Gly Ala Thr Gly Val Glu Leu Ser Ala Glu Leu His Asn Ala
180 185 190

Val Lys Gln Leu His Ser Tyr Gly Tyr Lys Gly Leu Thr Asn Glu Ala
195 200 205

Leu Asn Val Thr Leu Val Glu Ala Gly Glu Arg Ile Leu Pro Ala Leu
210 215 220

Pro Pro Arg Ile Ser Ala Ala Ala His Asn Glu Leu Thr Lys Leu Gly
225 230 235 240

Val Arg Val Leu Thr Gln Thr Met Val Thr Ser Ala Asp Glu Gly Gly
245 250 255

Leu His Thr Lys Asp Gly Glu Tyr Ile Glu Ala Asp Leu Met Val Trp
260 265 270

Ala Ala Gly Ile Lys Ala Pro Asp Phe Leu Lys Asp Ile Gly Gly Leu
275 280 285

Glu Thr Asn Arg Ile Asn Gln Leu Val Val Glu Pro Thr Leu Gln Thr
290 295 300

Thr Arg Asp Pro Asp Ile Tyr Ala Ile Gly Asp Cys Ala Ser Cys Pro
305 310 315 320

Arg Pro Glu Gly Gly Phe Val Pro Pro Arg Ala Gln Ala Ala His Gln
325 330 335

Met Ala Thr Cys Ala Met Asn Asn Ile Leu Ala Gln Met Asn Gly Lys
340 345 350

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Pro Leu Lys Asn Tyr Gln Tyr Lys Asp His Gly Ser Leu Val Ser Leu
        355                 360                 365

Ser Asn Phe Ser Thr Val Gly Ser Leu Met Gly Asn Leu Thr Arg Gly
    370                 375                 380

Ser Met Met Ile Glu Gly Arg Ile Ala Arg Phe Val Tyr Ile Ser Leu
385                 390                 395                 400

Tyr Arg Met His Gln Ile Ala Leu His Gly Tyr Phe Lys Thr Gly Leu
                405                 410                 415

Met Met Leu Val Gly Ser Ile Asn Arg Val Ile Arg Pro Arg Leu Lys
            420                 425                 430

Leu His
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<210> 9

<211> 1296
<212> DNA
<213> Pseudomonas fluorescens

<220>
<221> CDS
<222>

<400> 9

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Met Thr His Arg Ile Val Ile Val Gly Gly Gly Ala Gly Gly Leu Glu
  1               5                  10                  15

ttg gct acc cgt ctg ggt aag act ctg ggc aag cgt ggc acg gcc agt   96
Leu Ala Thr Arg Leu Gly Lys Thr Leu Gly Lys Arg Gly Thr Ala Ser
            20                  25                  30

gtg atg ctg gtc gac gcg aac ctg acc cac atc tgg aaa ccg cta ctg   144
Val Met Leu Val Asp Ala Asn Leu Thr His Ile Trp Lys Pro Leu Leu
        35                  40                  45

cac gaa gtg gcc gcc ggc tcc ttg aac tcc tcc gaa gac gaa ctc aac   192
His Glu Val Ala Ala Gly Ser Leu Asn Ser Ser Glu Asp Glu Leu Asn
    50                  55                  60

tat gtc gcc cag gca aaa tgg aac cac ttc gag ttc cag ctc ggg cgc   240
Tyr Val Ala Gln Ala Lys Trp Asn His Phe Glu Phe Gln Leu Gly Arg
65                  70                  75                  80

atg agc ggc ctg gat cgc gag cgc aag aga atc caa ctg gcc gcc acc   288
Met Ser Gly Leu Asp Arg Glu Arg Lys Arg Ile Gln Leu Ala Ala Thr
```

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                    85                  90                  95

tat gac gag acc ggc gtc gag ctg ttg ccg gcc cgg gaa ctg ggc tac   336
Tyr Asp Glu Thr Gly Val Glu Leu Leu Pro Ala Arg Glu Leu Gly Tyr
            100                 105                 110

gac acc ctg gtg att gcc gtc ggc agc acc acc aat gac ttc ggc acc   384
Asp Thr Leu Val Ile Ala Val Gly Ser Thr Thr Asn Asp Phe Gly Thr
        115                 120                 125

gaa ggc gcg gcg cag cac tgc ctg ttc ctc gac acc cgc aaa cag gcc   432
Glu Gly Ala Ala Gln His Cys Leu Phe Leu Asp Thr Arg Lys Gln Ala
    130                 135                 140

gag cgc ttc cat cag caa ttg ctg cac cac tat ctg cgc gcc cac gcc   480
Glu Arg Phe His Gln Gln Leu Leu His His Tyr Leu Arg Ala His Ala
145                 150                 155                 160

ggg cag acc gat atc gtc gag cgc atc agc gtc gcc att gtc ggc gcc   528
Gly Gln Thr Asp Ile Val Glu Arg Ile Ser Val Ala Ile Val Gly Ala
                165                 170                 175

ggt gcg acc ggg gtc gaa ctg gcc gcc gag ctg cat aat gcc gcc cac   576
Gly Ala Thr Gly Val Glu Leu Ala Ala Glu Leu His Asn Ala Ala His
            180                 185                 190

gaa ctg cac gcc tac ggc ctg gac cgg atc aaa ccg gag aac atg cac   624
Glu Leu His Ala Tyr Gly Leu Asp Arg Ile Lys Pro Glu Asn Met His
        195                 200                 205

atc acc ctg atc gag gcc ggg cca cgc gtc ttg ccg gcc ctg ccg gag   672
Ile Thr Leu Ile Glu Ala Gly Pro Arg Val Leu Pro Ala Leu Pro Glu
    210                 215                 220

cgt atc ggc ggg ccg gtg cac aag acc ctg gaa aaa ctc ggg gtc aac   720
Arg Ile Gly Gly Pro Val His Lys Thr Leu Glu Lys Leu Gly Val Asn
225                 230                 235                 240

gtc atg acc aac gcc gcc gtc agc cag gtg acc gcc gac agc ctg att   768
Val Met Thr Asn Ala Ala Val Ser Gln Val Thr Ala Asp Ser Leu Ile
                245                 250                 255

acc gcg gac ggc aaa gtg atc gac gcg agc ctg aaa gtc tgg gcc gcc   816
Thr Ala Asp Gly Lys Val Ile Asp Ala Ser Leu Lys Val Trp Ala Ala
            260                 265                 270

ggg att cgc gcc ccg gac ttc ctc aag gac atc gac ggg ctg gag acc   864
Gly Ile Arg Ala Pro Asp Phe Leu Lys Asp Ile Asp Gly Leu Glu Thr
        275                 280                 285
```

```
aac cgg atc aac cag ttg cac gtg ctg ccc act ttg cag acc acc cgc   912
Asn Arg Ile Asn Gln Leu His Val Leu Pro Thr Leu Gln Thr Thr Arg
    290                 295                 300

gac gag aac atc ttc gcc ttc ggc gac tgc gcc gcc tgc ccg caa ccc   960
Asp Glu Asn Ile Phe Ala Phe Gly Asp Cys Ala Ala Cys Pro Gln Pro
305                 310                 315                 320

ggc agc gag cgc aac gtc cca cct cgc gcc cag gcc gca cac cag caa
1008
Gly Ser Glu Arg Asn Val Pro Pro Arg Ala Gln Ala Ala His Gln Gln
                325                 330                 335

gcc tca ctg ctg gcc aaa tcc ttg aag ctg cgg atc gag ggc aag gcc
1056
Ala Ser Leu Leu Ala Lys Ser Leu Lys Leu Arg Ile Glu Gly Lys Ala
            340                 345                 350

ctg ccg gaa tac aaa tac acc gac tac ggc tcg ctg atc tcg ctg tcg
1104
Leu Pro Glu Tyr Lys Tyr Thr Asp Tyr Gly Ser Leu Ile Ser Leu Ser
        355                 360                 365

cgg ttc tcg gca gtg ggc aac ctg atg ggt aac ctg acc ggc agc gtg
1152
Arg Phe Ser Ala Val Gly Asn Leu Met Gly Asn Leu Thr Gly Ser Val
    370                 375                 380

atg ctc gaa ggc tgg ctg gcg cgg atg ttc tat gtg tcg ctg tac cgc
1200
Met Leu Glu Gly Trp Leu Ala Arg Met Phe Tyr Val Ser Leu Tyr Arg
385                 390                 395                 400

atg cac cag atg gcg ctg tac ggc atg ttc cgc acg gcc atg ttg atg
1248
Met His Gln Met Ala Leu Tyr Gly Met Phe Arg Thr Ala Met Leu Met
                405                 410                 415

ctg ggt agc aag atc ggg cgt ggg acc gag cct cgg ctg aag ctg cac
1296
Leu Gly Ser Lys Ile Gly Arg Gly Thr Glu Pro Arg Leu Lys Leu His
            420                 425                 430
```

<210> 10
<211> 432
<212> PRT
<213> Pseudomonas fluorescens

<400> 10
Met Thr His Arg Ile Val Ile Val Gly Gly Gly Ala Gly Gly Leu Glu

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1               5                  10                  15
Leu Ala Thr Arg Leu Gly Lys Thr Leu Gly Lys Arg Gly Thr Ala Ser
            20                  25                  30
Val Met Leu Val Asp Ala Asn Leu Thr His Ile Trp Lys Pro Leu Leu
        35                  40                  45
His Glu Val Ala Ala Gly Ser Leu Asn Ser Ser Glu Asp Glu Leu Asn
    50                  55                  60
Tyr Val Ala Gln Ala Lys Trp Asn His Phe Glu Phe Gln Leu Gly Arg
65                  70                  75                  80
Met Ser Gly Leu Asp Arg Glu Arg Lys Arg Ile Gln Leu Ala Ala Thr
                85                  90                  95
Tyr Asp Glu Thr Gly Val Glu Leu Leu Pro Ala Arg Glu Leu Gly Tyr
            100                 105                 110
Asp Thr Leu Val Ile Ala Val Gly Ser Thr Thr Asn Asp Phe Gly Thr
        115                 120                 125
Glu Gly Ala Ala Gln His Cys Leu Phe Leu Asp Thr Arg Lys Gln Ala
    130                 135                 140
Glu Arg Phe His Gln Gln Leu Leu His His Tyr Leu Arg Ala His Ala
145                 150                 155                 160
Gly Gln Thr Asp Ile Val Glu Arg Ile Ser Val Ala Ile Val Gly Ala
                165                 170                 175
Gly Ala Thr Gly Val Glu Leu Ala Ala Glu Leu His Asn Ala Ala His
            180                 185                 190
Glu Leu His Ala Tyr Gly Leu Asp Arg Ile Lys Pro Glu Asn Met His
        195                 200                 205
Ile Thr Leu Ile Glu Ala Gly Pro Arg Val Leu Pro Ala Leu Pro Glu
    210                 215                 220
Arg Ile Gly Gly Pro Val His Lys Thr Leu Glu Lys Leu Gly Val Asn
225                 230                 235                 240
Val Met Thr Asn Ala Ala Val Ser Gln Val Thr Ala Asp Ser Leu Ile
                245                 250                 255
Thr Ala Asp Gly Lys Val Ile Asp Ala Ser Leu Lys Val Trp Ala Ala
            260                 265                 270
```

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Gly Ile Arg Ala Pro Asp Phe Leu Lys Asp Ile Asp Gly Leu Glu Thr
        275                 280                 285

Asn Arg Ile Asn Gln Leu His Val Leu Pro Thr Leu Gln Thr Thr Arg
    290                 295                 300

Asp Glu Asn Ile Phe Ala Phe Gly Asp Cys Ala Ala Cys Pro Gln Pro
305                 310                 315                 320

Gly Ser Glu Arg Asn Val Pro Pro Arg Ala Gln Ala Ala His Gln Gln
                325                 330                 335

Ala Ser Leu Leu Ala Lys Ser Leu Lys Leu Arg Ile Glu Gly Lys Ala
            340                 345                 350

Leu Pro Glu Tyr Lys Tyr Thr Asp Tyr Gly Ser Leu Ile Ser Leu Ser
        355                 360                 365

Arg Phe Ser Ala Val Gly Asn Leu Met Gly Asn Leu Thr Gly Ser Val
    370                 375                 380

Met Leu Glu Gly Trp Leu Ala Arg Met Phe Tyr Val Ser Leu Tyr Arg
385                 390                 395                 400

Met His Gln Met Ala Leu Tyr Gly Met Phe Arg Thr Ala Met Leu Met
                405                 410                 415

Leu Gly Ser Lys Ile Gly Arg Gly Thr Glu Pro Arg Leu Lys Leu His
            420                 425                 430
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<210> 11
<211> 1296
<212> DNA
<213> Azotobacter vinelandii

<220>
<221> CDS
<222>

<400> 11

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atg act cat cgt atc gta atc gtc ggc ggt ggc gct ggc ggc gtg gaa   48
Met Thr His Arg Ile Val Ile Val Gly Gly Gly Ala Gly Gly Val Glu
  1               5                  10                  15

ctc gct acc cgc ctc ggc aag acc atg ggc agg aac ttc cag gcg aag   96
Leu Ala Thr Arg Leu Gly Lys Thr Met Gly Arg Asn Phe Gln Ala Lys
            20                  25                  30

atc acc ctg gtc gac gcc aac atg acc cac ctg tgg aaa ccg ctg ctg   144
Ile Thr Leu Val Asp Ala Asn Met Thr His Leu Trp Lys Pro Leu Leu
```

```
          35                  40                  45

cac gaa gtc gcc gcc ggc tcg ctg aac tcg acc ggc gac gaa ctg aac   192
His Glu Val Ala Ala Gly Ser Leu Asn Ser Thr Gly Asp Glu Leu Asn
     50                  55                  60

tat gtg gcc cag gcc aaa tgg aac aac ttc gag ttc cag tac ggc cgc   240
Tyr Val Ala Gln Ala Lys Trp Asn Asn Phe Glu Phe Gln Tyr Gly Arg
 65                  70                  75                  80

atg tgc ggt ctg gac cgg gcc aac aag cgt atc cgc ctg gcg gcc cag   288
Met Cys Gly Leu Asp Arg Ala Asn Lys Arg Ile Arg Leu Ala Ala Gln
                 85                  90                  95

ccg gcc cag gaa gat cgc gcg ccc ctg ccc gag cgc gaa ctg gaa tac   336
Pro Ala Gln Glu Asp Arg Ala Pro Leu Pro Glu Arg Glu Leu Glu Tyr
            100                 105                 110

gac acc ctg gtc ctt tcc gtc ggc agc acc acc aat gac ttc ggc acc   384
Asp Thr Leu Val Leu Ser Val Gly Ser Thr Thr Asn Asp Phe Gly Thr
        115                 120                 125

ccg ggc gcc gcc gag aac tgt att ttc ctg gaa ggc cgc gac cag gcc   432
Pro Gly Ala Ala Glu Asn Cys Ile Phe Leu Glu Gly Arg Asp Gln Ala
    130                 135                 140

gag cgt ttc cgc cgt ccg ctg ctc agc cac tac ttg cgt gcc cac gcc   480
Glu Arg Phe Arg Arg Pro Leu Leu Ser His Tyr Leu Arg Ala His Ala
145                 150                 155                 160

agc aat gac gac ggc cat cag gtc aag gtc gcc atc gtc ggc gcc ggt   528
Ser Asn Asp Asp Gly His Gln Val Lys Val Ala Ile Val Gly Ala Gly
                165                 170                 175

gcc acc ggg gtc gaa ctg gcc gca gaa ctg cgc cac gcc tcc aag gaa   576
Ala Thr Gly Val Glu Leu Ala Ala Glu Leu Arg His Ala Ser Lys Glu
            180                 185                 190

ctg gtc gcc tat ggg ctg gag cgc att ccg ccg gag aac ctc agc atc   624
Leu Val Ala Tyr Gly Leu Glu Arg Ile Pro Pro Glu Asn Leu Ser Ile
        195                 200                 205

acg ctg atc gaa tcc agc ccg cgt gta ctc gcc gcc ctg ccc gaa cgc   672
Thr Leu Ile Glu Ser Ser Pro Arg Val Leu Ala Ala Leu Pro Glu Arg
    210                 215                 220

atc agc cgc tcc gcg cac gcc acc ctg gaa agc ctg ggc gtt cgc gtg   720
Ile Ser Arg Ser Ala His Ala Thr Leu Glu Ser Leu Gly Val Arg Val
225                 230                 235                 240
```

```
ctc gtc agc acc gcc gtc agc gag gtc acc gcg gaa ggc gtg aag acg   768
Leu Val Ser Thr Ala Val Ser Glu Val Thr Ala Glu Gly Val Lys Thr
                245                 250                 255

aag gac gac cag ttc atc ccc gcc gac ctc atg gtc tgg gcc gca ggc   816
Lys Asp Asp Gln Phe Ile Pro Ala Asp Leu Met Val Trp Ala Ala Gly
            260                 265                 270

gtc cgc gcg ccc gcc ttc ctc aag gag ctg gat ggt ctg gaa acc aat   864
Val Arg Ala Pro Ala Phe Leu Lys Glu Leu Asp Gly Leu Glu Thr Asn
        275                 280                 285

cgc atc aac cag ttg cag gtc cgc cag acc ctg cag act act ctg gac   912
Arg Ile Asn Gln Leu Gln Val Arg Gln Thr Leu Gln Thr Thr Leu Asp
    290                 295                 300

gac gat atc ttc gcc ttc ggc gat tgt gcc tcc tgc ccg cag ccg ggt   960
Asp Asp Ile Phe Ala Phe Gly Asp Cys Ala Ser Cys Pro Gln Pro Gly
305                 310                 315                 320

acc gac cgc ccc gtt ccg ccg cgc gcc cag gcc gct cac cag cag gcc
1008
Thr Asp Arg Pro Val Pro Pro Arg Ala Gln Ala Ala His Gln Gln Ala
                325                 330                 335

agc ctg ctg gcc aag tcg ctc cac cgc aag ctg cag gaa gac agc ctc
1056
Ser Leu Leu Ala Lys Ser Leu His Arg Lys Leu Gln Glu Asp Ser Leu
            340                 345                 350

tgc tgg agt atc gct aca gcg aac cac ggc tcg ctg atc tcc ctc tcg
1104
Cys Trp Ser Ile Ala Thr Ala Asn His Gly Ser Leu Ile Ser Leu Ser
        355                 360                 365

agc ttc tcg gcg atc ggt aac ctg atg ggc aac ctg acc ggc aac gtg
1152
Ser Phe Ser Ala Ile Gly Asn Leu Met Gly Asn Leu Thr Gly Asn Val
    370                 375                 380

acc ttg gaa ggc tgg ctg gcc cgc aag ttc tac att tcc ctg tac cgc
1200
Thr Leu Glu Gly Trp Leu Ala Arg Lys Phe Tyr Ile Ser Leu Tyr Arg
385                 390                 395                 400

atg cac cag atg gcg ctc tac ggt acc ttc cgc acc ctg atg atg atg
1248
Met His Gln Met Ala Leu Tyr Gly Thr Phe Arg Thr Leu Met Met Met
                405                 410                 415
```

ctg ggc gac cgc ttc cgc agc agc acc gaa ccc cgc ctc aag ctt cac
1296
Leu Gly Asp Arg Phe Arg Ser Ser Thr Glu Pro Arg Leu Lys Leu His
420 425 430

<210> 12
<211> 432
<212> PRT
<213> Azotobacter vinelandii

<400> 12
Met Thr His Arg Ile Val Ile Val Gly Gly Gly Ala Gly Gly Val Glu
1 5 10 15

Leu Ala Thr Arg Leu Gly Lys Thr Met Gly Arg Asn Phe Gln Ala Lys
20 25 30

Ile Thr Leu Val Asp Ala Asn Met Thr His Leu Trp Lys Pro Leu Leu
35 40 45

His Glu Val Ala Ala Gly Ser Leu Asn Ser Thr Gly Asp Glu Leu Asn
50 55 60

Tyr Val Ala Gln Ala Lys Trp Asn Asn Phe Glu Phe Gln Tyr Gly Arg
65 70 75 80

Met Cys Gly Leu Asp Arg Ala Asn Lys Arg Ile Arg Leu Ala Ala Gln
85 90 95

Pro Ala Gln Glu Asp Arg Ala Pro Leu Pro Glu Arg Glu Leu Glu Tyr
100 105 110

Asp Thr Leu Val Leu Ser Val Gly Ser Thr Thr Asn Asp Phe Gly Thr
115 120 125

Pro Gly Ala Ala Glu Asn Cys Ile Phe Leu Glu Gly Arg Asp Gln Ala
130 135 140

Glu Arg Phe Arg Arg Pro Leu Leu Ser His Tyr Leu Arg Ala His Ala
145 150 155 160

Ser Asn Asp Asp Gly His Gln Val Lys Val Ala Ile Val Gly Ala Gly
165 170 175

Ala Thr Gly Val Glu Leu Ala Ala Glu Leu Arg His Ala Ser Lys Glu
180 185 190

Leu Val Ala Tyr Gly Leu Glu Arg Ile Pro Pro Glu Asn Leu Ser Ile
195 200 205

Thr Leu Ile Glu Ser Ser Pro Arg Val Leu Ala Ala Leu Pro Glu Arg
210 215 220

Ile Ser Arg Ser Ala His Ala Thr Leu Glu Ser Leu Gly Val Arg Val
225 230 235 240

Leu Val Ser Thr Ala Val Ser Glu Val Thr Ala Glu Gly Val Lys Thr
245 250 255

Lys Asp Asp Gln Phe Ile Pro Ala Asp Leu Met Val Trp Ala Ala Gly
260 265 270

Val Arg Ala Pro Ala Phe Leu Lys Glu Leu Asp Gly Leu Glu Thr Asn
275 280 285

Arg Ile Asn Gln Leu Gln Val Arg Gln Thr Leu Gln Thr Thr Leu Asp
290 295 300

Asp Asp Ile Phe Ala Phe Gly Asp Cys Ala Ser Cys Pro Gln Pro Gly
305 310 315 320

Thr Asp Arg Pro Val Pro Pro Arg Ala Gln Ala Ala His Gln Gln Ala
325 330 335

Ser Leu Leu Ala Lys Ser Leu His Arg Lys Leu Gln Glu Asp Ser Leu
340 345 350

Cys Trp Ser Ile Ala Thr Ala Asn His Gly Ser Leu Ile Ser Leu Ser
355 360 365

Ser Phe Ser Ala Ile Gly Asn Leu Met Gly Asn Leu Thr Gly Asn Val
370 375 380

Thr Leu Glu Gly Trp Leu Ala Arg Lys Phe Tyr Ile Ser Leu Tyr Arg
385 390 395 400

Met His Gln Met Ala Leu Tyr Gly Thr Phe Arg Thr Leu Met Met Met
405 410 415

Leu Gly Asp Arg Phe Arg Ser Ser Thr Glu Pro Arg Leu Lys Leu His
420 425 430

<210> 13

<211> 1302
<212> DNA
<213> Salmonella typhimurium LT2

<220>

<221> CDS
<222>

<400> 13

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ttg act aca cca tta aaa aag atc gtg att gtc ggc ggc ggc gct ggc   48
Met Thr Thr Pro Leu Lys Lys Ile Val Ile Val Gly Gly Gly Ala Gly
  1               5                  10                  15

ggg ctg gaa atg gcg acg cag tta ggc cat aaa ctg ggg cgc aag aaa   96
Gly Leu Glu Met Ala Thr Gln Leu Gly His Lys Leu Gly Arg Lys Lys
            20                  25                  30

aaa gcg aaa atc acg ctg gta gac aga aat cac agc cat ctg tgg aaa   144
Lys Ala Lys Ile Thr Leu Val Asp Arg Asn His Ser His Leu Trp Lys
        35                  40                  45

cca ttg ctg cac gaa gtg gcg act ggc tct ctg gac gaa ggc gtg gat   192
Pro Leu Leu His Glu Val Ala Thr Gly Ser Leu Asp Glu Gly Val Asp
    50                  55                  60

gcg ctg agc tat ctg gct cat gcg cgt aat cat ggt ttc cag ttc cag   240
Ala Leu Ser Tyr Leu Ala His Ala Arg Asn His Gly Phe Gln Phe Gln
65                  70                  75                  80

ctg ggg tcg gtg atg gat atc gat cgc gaa gcg aaa acc atc acc att   288
Leu Gly Ser Val Met Asp Ile Asp Arg Glu Ala Lys Thr Ile Thr Ile
                85                  90                  95

gcc gag ttg cgt gat gaa aag ggc gaa ctg ctg gtg ccg gag cgc aaa   336
Ala Glu Leu Arg Asp Glu Lys Gly Glu Leu Leu Val Pro Glu Arg Lys
            100                 105                 110

atc gcg tat gac acg ctg gtg atg gcg ctg ggc agc acc tct aat gat   384
Ile Ala Tyr Asp Thr Leu Val Met Ala Leu Gly Ser Thr Ser Asn Asp
        115                 120                 125

ttc aac acg ccg ggc gtg aaa gag cac tgt atc ttc ctc gat aac ccg   432

Phe Asn Thr Pro Gly Val Lys Glu His Cys Ile Phe Leu Asp Asn Pro
    130                 135                 140

cat cag gcg cgc cgt ttt cac cag gag atg ctg aac ctg ttc ctc aag   480
His Gln Ala Arg Arg Phe His Gln Glu Met Leu Asn Leu Phe Leu Lys
145                 150                 155                 160

tat tcg gct aat ctg ggc gcg aac ggt aag gtc aat atc gcc atc gtt   528
Tyr Ser Ala Asn Leu Gly Ala Asn Gly Lys Val Asn Ile Ala Ile Val
                165                 170                 175
```

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ggc ggc ggt gcg acg ggg gtt gag ctg tcg gct gaa ctg cat aat gcg   576
Gly Gly Gly Ala Thr Gly Val Glu Leu Ser Ala Glu Leu His Asn Ala
            180                 185                 190

gta aaa cag ctg cat agc tat ggt tat aag ggg ctg acc aac gac gcg   624
Val Lys Gln Leu His Ser Tyr Gly Tyr Lys Gly Leu Thr Asn Asp Ala
        195                 200                 205

ctg aac gtg acg ttg gtt gag gct ggc gag cgt att ctg cct gcg ttg   672
Leu Asn Val Thr Leu Val Glu Ala Gly Glu Arg Ile Leu Pro Ala Leu
    210                 215                 220

ccg ccg cgt atc tcc agc gcc gcg cat aat gaa ctg acc aaa ctg ggc   720
Pro Pro Arg Ile Ser Ser Ala Ala His Asn Glu Leu Thr Lys Leu Gly
225                 230                 235                 240

gtt cgc gtg ctg acg caa act atg gtc acc agc gcc gac gaa ggc ggt   768
Val Arg Val Leu Thr Gln Thr Met Val Thr Ser Ala Asp Glu Gly Gly
                245                 250                 255

ctg cat acg aaa gaa ggt gaa tat att cag gcc gat ctg atg gtg tgg   816
Leu His Thr Lys Glu Gly Glu Tyr Ile Gln Ala Asp Leu Met Val Trp
            260                 265                 270

gcg gcg ggt atc aaa gcg cca gat ttt atg aaa gag att ggt ggt ctg   864
Ala Ala Gly Ile Lys Ala Pro Asp Phe Met Lys Glu Ile Gly Gly Leu
        275                 280                 285

gaa acg aac cgc att aac caa ctg gtg gtg gaa ccg acg ctg caa acc   912
Glu Thr Asn Arg Ile Asn Gln Leu Val Val Glu Pro Thr Leu Gln Thr
    290                 295                 300

acg cgc gat cct gat att tat gcg att ggc gac tgc gct tcc tgc gca   960
Thr Arg Asp Pro Asp Ile Tyr Ala Ile Gly Asp Cys Ala Ser Cys Ala
305                 310                 315                 320

cgt ccg gag gga ggt ttt gtg ccg cct cgc gct cag gcg gcg cat cag
1008
Arg Pro Glu Gly Gly Phe Val Pro Pro Arg Ala Gln Ala Ala His Gln
                325                 330                 335

atg gct acc tgc gcg atg aaa aac att ctg gcg cag atg aat ggc aaa
1056
Met Ala Thr Cys Ala Met Lys Asn Ile Leu Ala Gln Met Asn Gly Lys
            340                 345                 350

ccg ctg aaa gct tac cag tat aaa gat cat gga tcg ctg gtc tct ctg
1104
Pro Leu Lys Ala Tyr Gln Tyr Lys Asp His Gly Ser Leu Val Ser Leu
        355                 360                 365
```

```
tcc aac ttc tct acc gtg ggt agt ctg atg ggg aac ctg acc cgc ggt
1152
Ser Asn Phe Ser Thr Val Gly Ser Leu Met Gly Asn Leu Thr Arg Gly
    370                 375                 380

tca atg atg att gaa gga cgt atc gcc cgc ttc gtg tat atc tcg cta
1200
Ser Met Met Ile Glu Gly Arg Ile Ala Arg Phe Val Tyr Ile Ser Leu
385                 390                 395                 400

tac cgt atg cac cag ata gcg ctg cat gga tac ttt aaa acc ggc ctg
1248
Tyr Arg Met His Gln Ile Ala Leu His Gly Tyr Phe Lys Thr Gly Leu
                405                 410                 415

atg atg ctg gtg ggc agt att aac cgc gtc att cgt ccg cgc ctg aaa
1296
Met Met Leu Val Gly Ser Ile Asn Arg Val Ile Arg Pro Arg Leu Lys
            420                 425                 430

ctg cat                                                        1302
Leu His
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<210> 14
<211> 434
<212> PRT
<213> Salmonella typhimurium LT2

<400> 14

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Met Thr Thr Pro Leu Lys Lys Ile Val Ile Val Gly Gly Gly Ala Gly
  1               5                  10                  15

Gly Leu Glu Met Ala Thr Gln Leu Gly His Lys Leu Gly Arg Lys Lys
             20                  25                  30

Lys Ala Lys Ile Thr Leu Val Asp Arg Asn His Ser His Leu Trp Lys
         35                  40                  45

Pro Leu Leu His Glu Val Ala Thr Gly Ser Leu Asp Glu Gly Val Asp
     50                  55                  60

Ala Leu Ser Tyr Leu Ala His Ala Arg Asn His Gly Phe Gln Phe Gln
 65                  70                  75                  80

Leu Gly Ser Val Met Asp Ile Asp Arg Glu Ala Lys Thr Ile Thr Ile
                 85                  90                  95

Ala Glu Leu Arg Asp Glu Lys Gly Glu Leu Leu Val Pro Glu Arg Lys
            100                 105                 110
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Ile Ala Tyr Asp Thr Leu Val Met Ala Leu Gly Ser Thr Ser Asn Asp
115 120 125

Phe Asn Thr Pro Gly Val Lys Glu His Cys Ile Phe Leu Asp Asn Pro
130 135 140

His Gln Ala Arg Arg Phe His Gln Glu Met Leu Asn Leu Phe Leu Lys
145 150 155 160

Tyr Ser Ala Asn Leu Gly Ala Asn Gly Lys Val Asn Ile Ala Ile Val
165 170 175

Gly Gly Gly Ala Thr Gly Val Glu Leu Ser Ala Glu Leu His Asn Ala
180 185 190

Val Lys Gln Leu His Ser Tyr Gly Tyr Lys Gly Leu Thr Asn Asp Ala
195 200 205

Leu Asn Val Thr Leu Val Glu Ala Gly Glu Arg Ile Leu Pro Ala Leu
210 215 220

Pro Pro Arg Ile Ser Ser Ala Ala His Asn Glu Leu Thr Lys Leu Gly
225 230 235 240

Val Arg Val Leu Thr Gln Thr Met Val Thr Ser Ala Asp Glu Gly Gly
245 250 255

Leu His Thr Lys Glu Gly Glu Tyr Ile Gln Ala Asp Leu Met Val Trp
260 265 270

Ala Ala Gly Ile Lys Ala Pro Asp Phe Met Lys Glu Ile Gly Gly Leu
275 280 285

Glu Thr Asn Arg Ile Asn Gln Leu Val Val Glu Pro Thr Leu Gln Thr
290 295 300

Thr Arg Asp Pro Asp Ile Tyr Ala Ile Gly Asp Cys Ala Ser Cys Ala
305 310 315 320

Arg Pro Glu Gly Gly Phe Val Pro Pro Arg Ala Gln Ala Ala His Gln
325 330 335

Met Ala Thr Cys Ala Met Lys Asn Ile Leu Ala Gln Met Asn Gly Lys
340 345 350

Pro Leu Lys Ala Tyr Gln Tyr Lys Asp His Gly Ser Leu Val Ser Leu
355 360 365

Ser Asn Phe Ser Thr Val Gly Ser Leu Met Gly Asn Leu Thr Arg Gly

```
    370                 375                 380

Ser Met Met Ile Glu Gly Arg Ile Ala Arg Phe Val Tyr Ile Ser Leu
385                 390                 395                 400

Tyr Arg Met His Gln Ile Ala Leu His Gly Tyr Phe Lys Thr Gly Leu
                405                 410                 415

Met Met Leu Val Gly Ser Ile Asn Arg Val Ile Arg Pro Arg Leu Lys
            420                 425                 430

Leu His
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atg gca aag aaa aat att gtc gtt gtc ggt gcg ggg ttt gct ggt gtt   48
Met Ala Lys Lys Asn Ile Val Val Val Gly Ala Gly Phe Ala Gly Val
  1               5                  10                  15

tac gca acc aag aaa ctg tct aag cat ttc aaa aaa aat gca gac gtc   96
Tyr Ala Thr Lys Lys Leu Ser Lys His Phe Lys Lys Asn Ala Asp Val
            20                  25                  30

gag att acg ttg att gac cgg cat tca tac ttc acg tat atg act gaa  144
Glu Ile Thr Leu Ile Asp Arg His Ser Tyr Phe Thr Tyr Met Thr Glu
        35                  40                  45

tta cat gaa gtt gct acc gaa cgg gtg gaa cct gag cat atc caa tat  192
Leu His Glu Val Ala Thr Glu Arg Val Glu Pro Glu His Ile Gln Tyr
    50                  55                  60

gat ttg caa cgg ttg ttc gca cgg cga aaa aac gtt cgt ctc gtg acc  240
Asp Leu Gln Arg Leu Phe Ala Arg Arg Lys Asn Val Arg Leu Val Thr
65                  70                  75                  80

gat acc gtg acg ggc atc gac aaa aag gca caa aca gtt act acc gaa  288
Asp Thr Val Thr Gly Ile Asp Lys Lys Ala Gln Thr Val Thr Thr Glu
                85                  90                  95

cac gga agt tat caa tat gat caa ctt tta att agt ttg ggt ggg gaa  336
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His Gly Ser Tyr Gln Tyr Asp Gln Leu Leu Ile Ser Leu Gly Gly Glu
                100                 105                 110

tcc aat gac ttt ggg act ccc ggt gtt aag gaa cac ggc ttc gaa ttg   384
Ser Asn Asp Phe Gly Thr Pro Gly Val Lys Glu His Gly Phe Glu Leu
        115                 120                 125

tgg tcc ttc gaa caa gcg atg gca ttg cgc gct cac tta tct gca att   432
Trp Ser Phe Glu Gln Ala Met Ala Leu Arg Ala His Leu Ser Ala Ile
    130                 135                 140

att cgg cgg ggg gcg gcg gag ctc gac cct gct aag cgc aaa gcc atg   480
Ile Arg Arg Gly Ala Ala Glu Leu Asp Pro Ala Lys Arg Lys Ala Met
145                 150                 155                 160

ttg acc ttt aca gtc tgt ggt tct ggt ttt act ggt tct gaa ctg att   528
Leu Thr Phe Thr Val Cys Gly Ser Gly Phe Thr Gly Ser Glu Leu Ile
                165                 170                 175

ggt gaa tta atc gaa tat cgt gat gtt ttg gct cga gac aac aag ctc   576
Gly Glu Leu Ile Glu Tyr Arg Asp Val Leu Ala Arg Asp Asn Lys Leu
            180                 185                 190

gat cca agt gaa atc acg ctc caa ttg gtc gaa gca gcg ccg act att   624
Asp Pro Ser Glu Ile Thr Leu Gln Leu Val Glu Ala Ala Pro Thr Ile
        195                 200                 205

att aac atg ctc aac cgg acg caa gcc ggt aag gcc gct aag tac atg   672
Ile Asn Met Leu Asn Arg Thr Gln Ala Gly Lys Ala Ala Lys Tyr Met
    210                 215                 220

gaa aaa cat ggt gtc aaa atc atg acg aac tcc atg att acc gaa gtc   720
Glu Lys His Gly Val Lys Ile Met Thr Asn Ser Met Ile Thr Glu Val
225                 230                 235                 240

tgt gaa gac cat gtt aac tta aaa ggc aag gat cca att cca acc tac   768
Cys Glu Asp His Val Asn Leu Lys Gly Lys Asp Pro Ile Pro Thr Tyr
                245                 250                 255

acg tta atc tgg aca gcc ggt gtt cgt gct aat agt atc gtt aaa aag   816
Thr Leu Ile Trp Thr Ala Gly Val Arg Ala Asn Ser Ile Val Lys Lys
            260                 265                 270

ttc ggc att gaa act aac ccc cgc ggt ggt cgc ttg atg gcc aat gaa   864
Phe Gly Ile Glu Thr Asn Pro Arg Gly Gly Arg Leu Met Ala Asn Glu
        275                 280                 285

ttc atg caa gct aag gat tgt aac aat atc ttc tta gcc ggt gat tca   912
Phe Met Gln Ala Lys Asp Cys Asn Asn Ile Phe Leu Ala Gly Asp Ser
    290                 295                 300
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acc agc tac caa gaa cct gac caa cca cgg cca gtc cca caa atc gtt   960
Thr Ser Tyr Gln Glu Pro Asp Gln Pro Arg Pro Val Pro Gln Ile Val
305                 310                 315                 320

caa ggg gct gaa gaa acc gca gct aag gcc gtc gaa ggt att att aag
1008
Gln Gly Ala Glu Glu Thr Ala Ala Lys Ala Val Glu Gly Ile Ile Lys
                325                 330                 335

aac gtt gac cag act gac gtt acg atc aag cca ttt aag ggc gct tat
1056
Asn Val Asp Gln Thr Asp Val Thr Ile Lys Pro Phe Lys Gly Ala Tyr
            340                 345                 350

caa gca tcc gtc gac tca att ggt tcc aaa tat gcc gtt gca caa gtt
1104
Gln Ala Ser Val Asp Ser Ile Gly Ser Lys Tyr Ala Val Ala Gln Val
        355                 360                 365

tta gag aag tgg aac gtc tct ggt ttt att gcc gtg ctt tta aaa cac
1152
Leu Glu Lys Trp Asn Val Ser Gly Phe Ile Ala Val Leu Leu Lys His
    370                 375                 380

gcc atc aac tgg atg tac tac gtt cag att ttc tca ggt tac tac cta
1200
Ala Ile Asn Trp Met Tyr Tyr Val Gln Ile Phe Ser Gly Tyr Tyr Leu
385                 390                 395                 400

ttc cag tac ttc atg cac gaa ttc ttc cgg act cgt aat aac cgt aac
1248
Phe Gln Tyr Phe Met His Glu Phe Phe Arg Thr Arg Asn Asn Arg Asn
                405                 410                 415

gtc ttc cgc ggt tgg gtc tca cgg gct ggt aac gta ctc tgg agt gtg
1296
Val Phe Arg Gly Trp Val Ser Arg Ala Gly Asn Val Leu Trp Ser Val
            420                 425                 430

cca ctg cgg ttc ttc tat ggt gcc atg tgg tta tgg gac tgc tgg act
1344
Pro Leu Arg Phe Phe Tyr Gly Ala Met Trp Leu Trp Asp Cys Trp Thr
        435                 440                 445

aaa gtt cag gga tct gaa tcc tgg ttc act gac aag tta cgg tta cca
1392
Lys Val Gln Gly Ser Glu Ser Trp Phe Thr Asp Lys Leu Arg Leu Pro
    450                 455                 460
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ttc gaa tgg att acc gtg gcc gca acc agt ggt gcc tct caa gca act
1440
Phe Glu Trp Ile Thr Val Ala Ala Thr Ser Gly Ala Ser Gln Ala Thr
465                 470                 475                 480

aaa gcc gct gca acc agt ggt gct tct gaa gct gcc acg tca acc gtt
1488
Lys Ala Ala Ala Thr Ser Gly Ala Ser Glu Ala Ala Thr Ser Thr Val
                485                 490                 495

aaa gcc gct aag ggt gtc ttc agt ctt tca tac atg tac ggt aaa gaa
1536
Lys Ala Ala Lys Gly Val Phe Ser Leu Ser Tyr Met Tyr Gly Lys Glu
            500                 505                 510

ccc ctg atg gtc ttt gac aaa atg cca cat tgg ttc gaa tca att acc
1584
Pro Leu Met Val Phe Asp Lys Met Pro His Trp Phe Glu Ser Ile Thr
        515                 520                 525

aag gtc ttc att ccg aac atg caa atg gcc ctc ttc ttc cag aaa ttc
1632
Lys Val Phe Ile Pro Asn Met Gln Met Ala Leu Phe Phe Gln Lys Phe
    530                 535                 540

atg act tgt gtt gaa atc gtc att gca tta tgt att ttc ttc gga ctc
1680
Met Thr Cys Val Glu Ile Val Ile Ala Leu Cys Ile Phe Phe Gly Leu
545                 550                 555                 560

ttt act tgg ttt gct aac gca gtc acc att ggc tta gtt gtc gtc ttc
1728
Phe Thr Trp Phe Ala Asn Ala Val Thr Ile Gly Leu Val Val Val Phe
                565                 570                 575

tgc tta tct ggc atg ttc tac tgg gtc aac att tgg atg atc ttt gtt
1776
Cys Leu Ser Gly Met Phe Tyr Trp Val Asn Ile Trp Met Ile Phe Val
            580                 585                 590

gcc ctc gcc tta atg aac ggt tcc gga cgg aca ttt ggg tta gac tac
1824
Ala Leu Ala Leu Met Asn Gly Ser Gly Arg Thr Phe Gly Leu Asp Tyr
        595                 600                 605

tgg gtc gtt ccg tgg atg caa aaa cac ctt gga cac tgg tgg tac ggc
1872
Trp Val Val Pro Trp Met Gln Lys His Leu Gly His Trp Trp Tyr Gly
    610                 615                 620
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aac gtt cgt tct cat tac gac ggt gtt aaa acc cgc                1908
Asn Val Arg Ser His Tyr Asp Gly Val Lys Thr Arg
625                 630                 635
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Met Ala Lys Lys Asn Ile Val Val Val Gly Ala Gly Phe Ala Gly Val
  1               5                  10                  15

Tyr Ala Thr Lys Lys Leu Ser Lys His Phe Lys Lys Asn Ala Asp Val
            20                  25                  30

Glu Ile Thr Leu Ile Asp Arg His Ser Tyr Phe Thr Tyr Met Thr Glu
        35                  40                  45

Leu His Glu Val Ala Thr Glu Arg Val Glu Pro Glu His Ile Gln Tyr
    50                  55                  60

Asp Leu Gln Arg Leu Phe Ala Arg Arg Lys Asn Val Arg Leu Val Thr
65                  70                  75                  80

Asp Thr Val Thr Gly Ile Asp Lys Lys Ala Gln Thr Val Thr Thr Glu
                85                  90                  95

His Gly Ser Tyr Gln Tyr Asp Gln Leu Leu Ile Ser Leu Gly Gly Glu
            100                 105                 110

Ser Asn Asp Phe Gly Thr Pro Gly Val Lys Glu His Gly Phe Glu Leu
        115                 120                 125

Trp Ser Phe Glu Gln Ala Met Ala Leu Arg Ala His Leu Ser Ala Ile
    130                 135                 140

Ile Arg Arg Gly Ala Ala Glu Leu Asp Pro Ala Lys Arg Lys Ala Met
145                 150                 155                 160

Leu Thr Phe Thr Val Cys Gly Ser Gly Phe Thr Gly Ser Glu Leu Ile
                165                 170                 175

Gly Glu Leu Ile Glu Tyr Arg Asp Val Leu Ala Arg Asp Asn Lys Leu
            180                 185                 190

Asp Pro Ser Glu Ile Thr Leu Gln Leu Val Glu Ala Ala Pro Thr Ile
        195                 200                 205

Ile Asn Met Leu Asn Arg Thr Gln Ala Gly Lys Ala Ala Lys Tyr Met
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    210                 215                 220

Glu Lys His Gly Val Lys Ile Met Thr Asn Ser Met Ile Thr Glu Val
225                 230                 235                 240

Cys Glu Asp His Val Asn Leu Lys Gly Lys Asp Pro Ile Pro Thr Tyr
                245                 250                 255

Thr Leu Ile Trp Thr Ala Gly Val Arg Ala Asn Ser Ile Val Lys Lys
            260                 265                 270

Phe Gly Ile Glu Thr Asn Pro Arg Gly Gly Arg Leu Met Ala Asn Glu
        275                 280                 285

Phe Met Gln Ala Lys Asp Cys Asn Asn Ile Phe Leu Ala Gly Asp Ser
    290                 295                 300

Thr Ser Tyr Gln Glu Pro Asp Gln Pro Arg Pro Val Pro Gln Ile Val
305                 310                 315                 320

Gln Gly Ala Glu Glu Thr Ala Ala Lys Ala Val Glu Gly Ile Ile Lys
                325                 330                 335

Asn Val Asp Gln Thr Asp Val Thr Ile Lys Pro Phe Lys Gly Ala Tyr
            340                 345                 350

Gln Ala Ser Val Asp Ser Ile Gly Ser Lys Tyr Ala Val Ala Gln Val
        355                 360                 365

Leu Glu Lys Trp Asn Val Ser Gly Phe Ile Ala Val Leu Leu Lys His
    370                 375                 380

Ala Ile Asn Trp Met Tyr Tyr Val Gln Ile Phe Ser Gly Tyr Tyr Leu
385                 390                 395                 400

Phe Gln Tyr Phe Met His Glu Phe Phe Arg Thr Arg Asn Asn Arg Asn
                405                 410                 415

Val Phe Arg Gly Trp Val Ser Arg Ala Gly Asn Val Leu Trp Ser Val
            420                 425                 430

Pro Leu Arg Phe Phe Tyr Gly Ala Met Trp Leu Trp Asp Cys Trp Thr
        435                 440                 445

Lys Val Gln Gly Ser Glu Ser Trp Phe Thr Asp Lys Leu Arg Leu Pro
    450                 455                 460

Phe Glu Trp Ile Thr Val Ala Ala Thr Ser Gly Ala Ser Gln Ala Thr
465                 470                 475                 480
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Lys Ala Ala Ala Thr Ser Gly Ala Ser Glu Ala Ala Thr Ser Thr Val
485 490 495

Lys Ala Ala Lys Gly Val Phe Ser Leu Ser Tyr Met Tyr Gly Lys Glu
500 505 510

Pro Leu Met Val Phe Asp Lys Met Pro His Trp Phe Glu Ser Ile Thr
515 520 525

Lys Val Phe Ile Pro Asn Met Gln Met Ala Leu Phe Phe Gln Lys Phe
530 535 540

Met Thr Cys Val Glu Ile Val Ile Ala Leu Cys Ile Phe Phe Gly Leu
545 550 555 560

Phe Thr Trp Phe Ala Asn Ala Val Thr Ile Gly Leu Val Val Val Phe
565 570 575

Cys Leu Ser Gly Met Phe Tyr Trp Val Asn Ile Trp Met Ile Phe Val
580 585 590

Ala Leu Ala Leu Met Asn Gly Ser Gly Arg Thr Phe Gly Leu Asp Tyr
595 600 605

Trp Val Val Pro Trp Met Gln Lys His Leu Gly His Trp Trp Tyr Gly
610 615 620

Asn Val Arg Ser His Tyr Asp Gly Val Lys Thr Arg
625 630 635